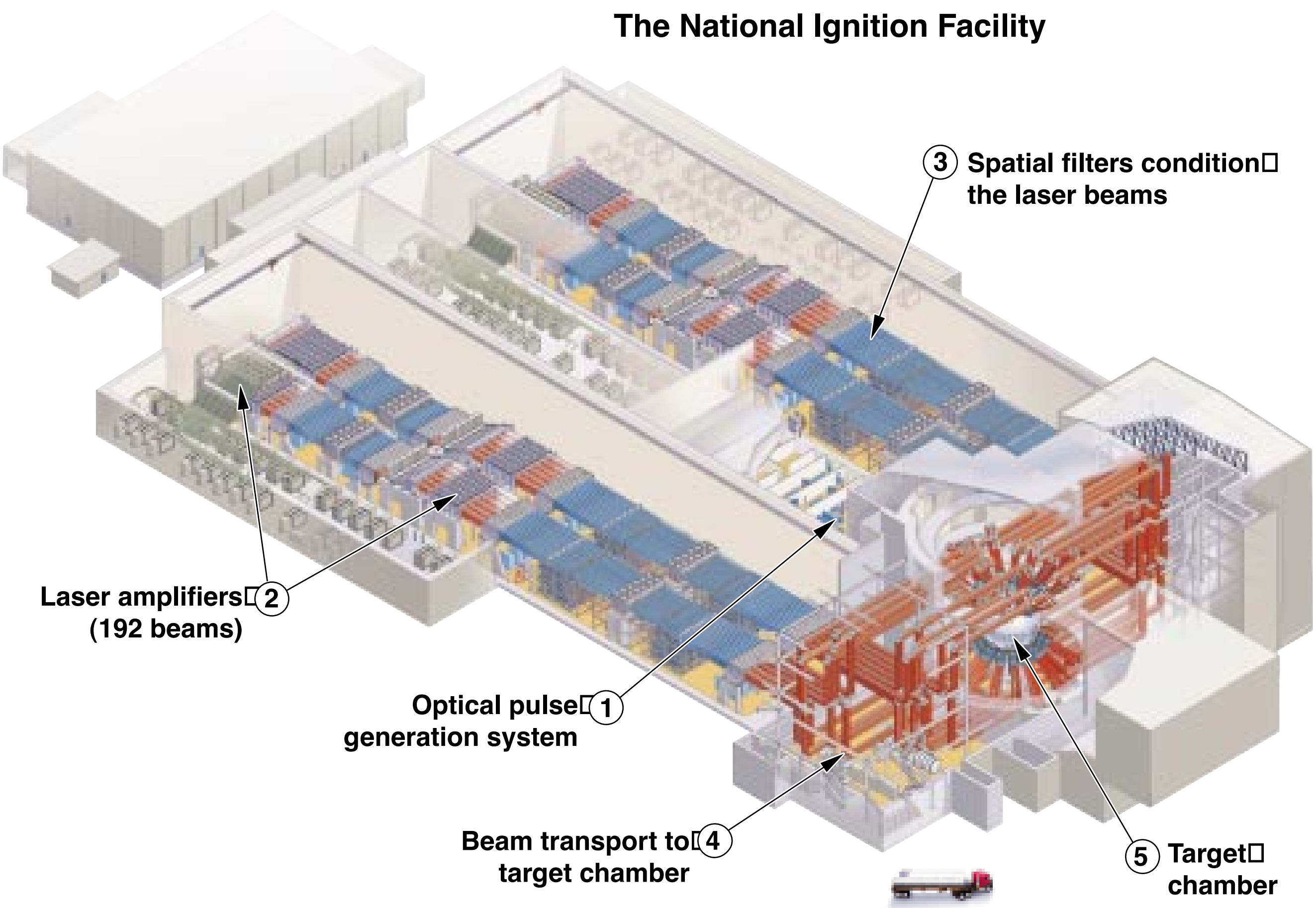
NIF NEWS
THE NATIONAL IGNITION FACILITY NEWSLETTER

A Star Is Born: What the NIF Is and How It Works

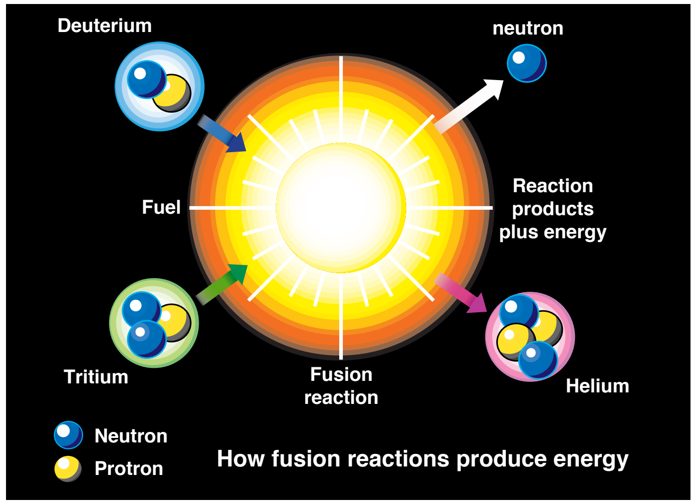
The Sun and the stars are natural fusion "power plants" that produce more energy than they consume, called energy gain. Scientists anticipate using the National Ignition Facility to achieve the long-sought goal of producing—for the first time in a laboratory—net energy gain from fusion ignition. NIF experiments will support the nuclear weapons Stockpile Stewardship and Management Program and will advance goals in national security, energy, basic science, and economic development.

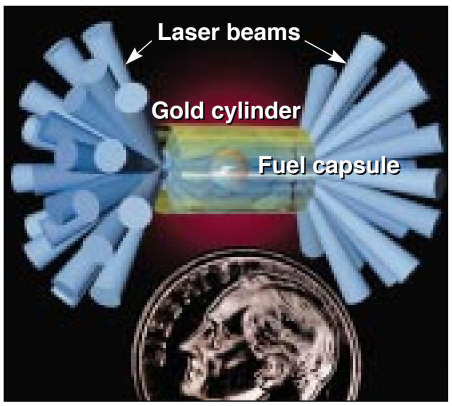
The National Ignition Facility

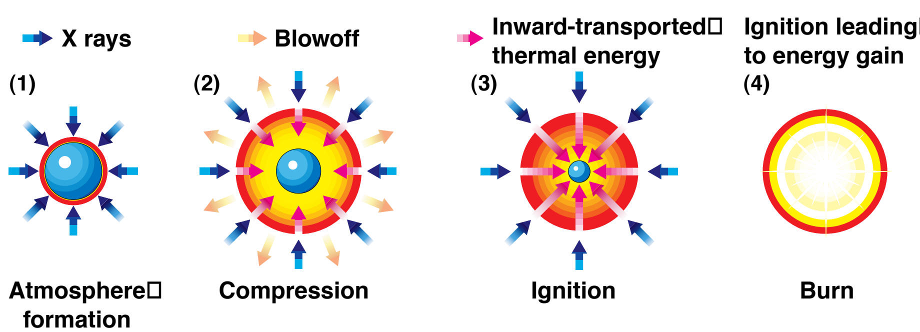


The heart of the National Ignition Facility (NIF) is a powerful laser whose energy will "ignite" small targets filled with fusion fuel. The NIF will (1) generate beams of laser light that are (2) amplified successively to greatly increase their energy, (3) conditioned to obtain the desired optical characteristics, and (4) transported through large beam tubes to a (5) target chamber, where the laser energy will compress and heat fusion targets to ignition.

Fusion is the process of combining or "fusing together" two light nuclei, releasing energy. Energy from the Sun comes from a series of fusion reactions occurring at extreme temperature and pressure. NIF experiments will re-create these conditions in a process called inertial confinement fusion.



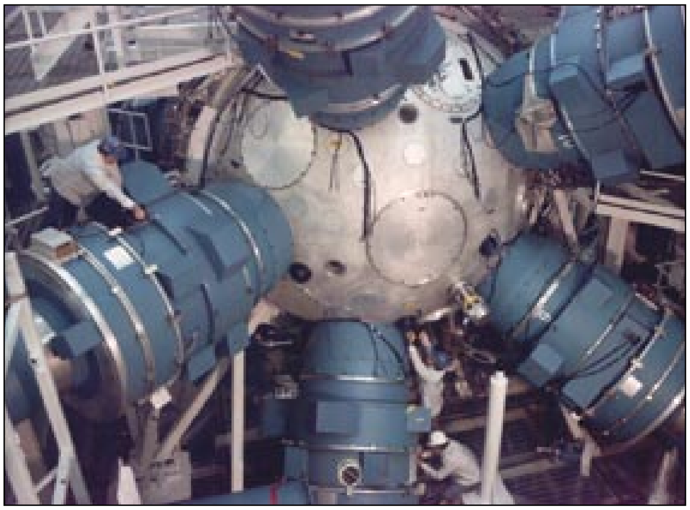




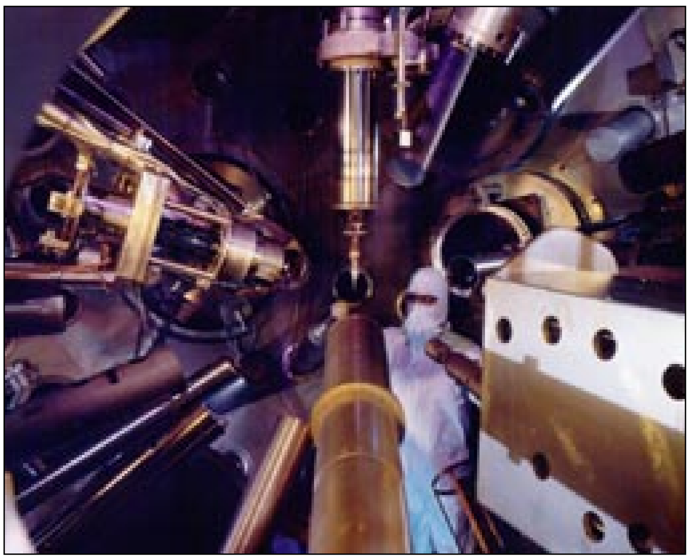
In indirect-drive experiments, the laser beams shine through holes and strike the inside wall of a small gold cylinder that holds a fusion fuel capsule. Laser energy heats the inside of the cylinder, creating x rays that surround the capsule. In direct-drive experiments, laser beams shine directly on the fuel capsule—there is no cylinder.

The x rays, or laser beams, rapidly (1) heat the capsule, (2) causing its surface to fly outward. This outward force causes an opposing inward force that compresses the fuel inside the capsule to a density 20 times that of lead. When the compression reaches the center, temperatures increase to 100,000,000°C, (3) igniting the fusion fuel and (4) producing a thermonuclear burn that yields many times the energy input (energy gain).

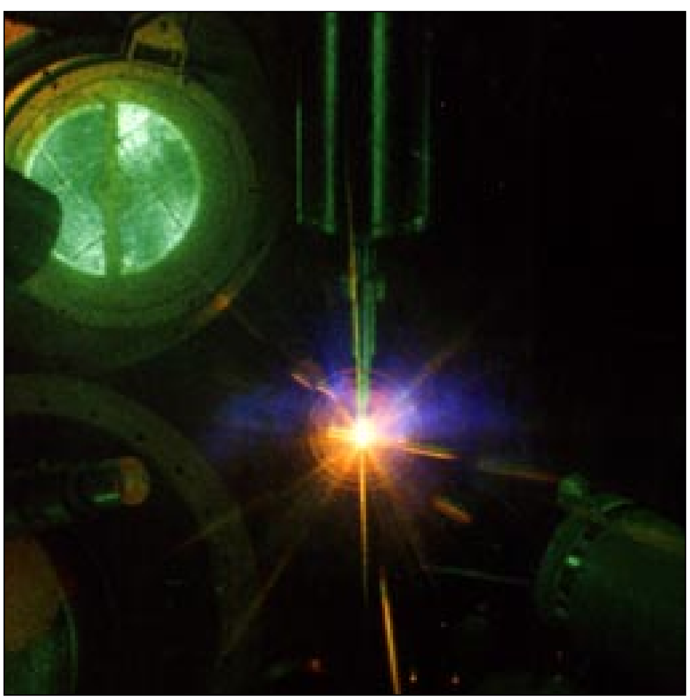
The Nova laser at Lawrence Livermore National Laboratory is the NIF's predecessor. In the Nova laser bay, the laser beams pass through these beam tubes to gradually build up their energy and power. Their total power is 100 times the total electric generating power of the United States (but only for one-billionth of a second!). The NIF will have 192 laser beams (compared to Nova's 10) and will produce 40 times more energy than Nova and 10 times more power.



At left is the target chamber where Nova's laser beams are focused on a fusion target about the size of a grain of sand. The NIF target will be about four times as large (the size of a BB), so the compressed target will capture some of the fusion energy and ignite more fuel. This self-sustained process is called ignition and is the key to obtaining high energy gain in fusion targets.



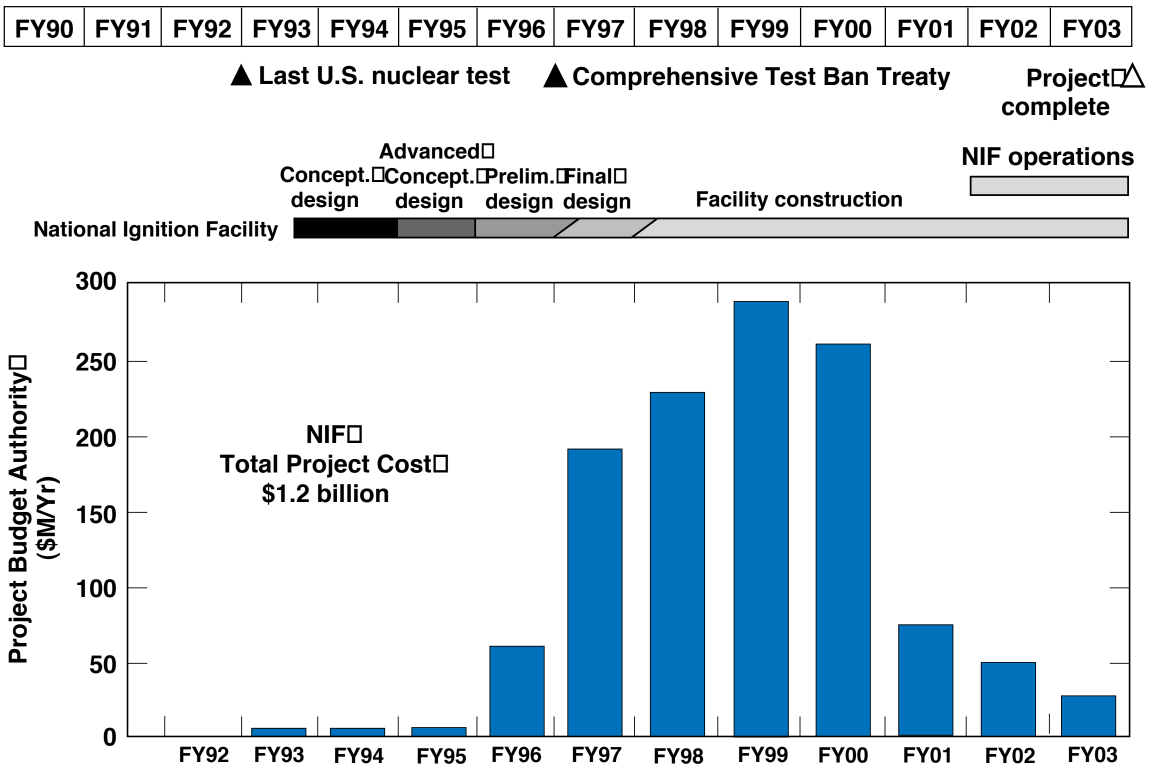
Inside the target chamber, the fusion target is lowered on a vertical stalk. Instruments pointed at the target measure the laser's performance.



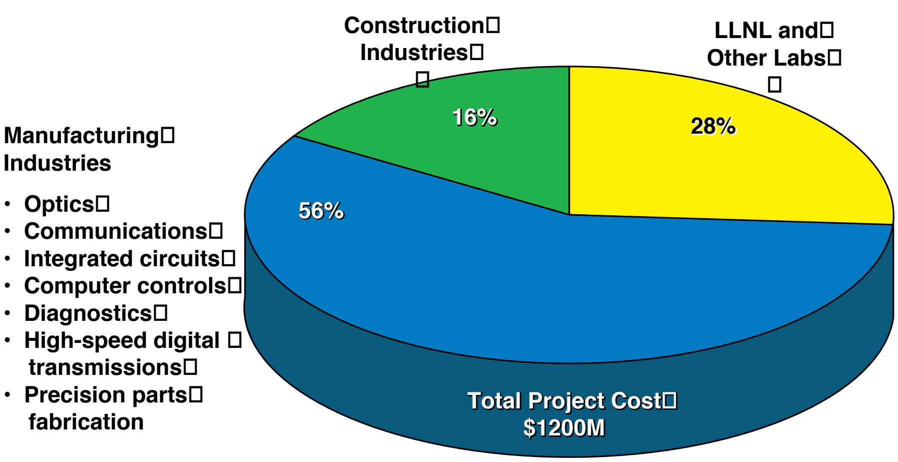
When the lasers fire and the target "burns" with fusion reactions, the temperature and pressure inside the target are the same as inside the Sun or inside an exploding nuclear weapon. The tiny flash of light is, for one-billionth of a second, a tiny man-made star.

In Nova, fusion reactions occur, but ignition and energy gain are not obtained. In the NIF, fusion ignition will occur and an energy gain of 1 to 10 times the input energy is expected. NIF experiments will be used for nuclear weapons, fusion energy, and basic science purposes.

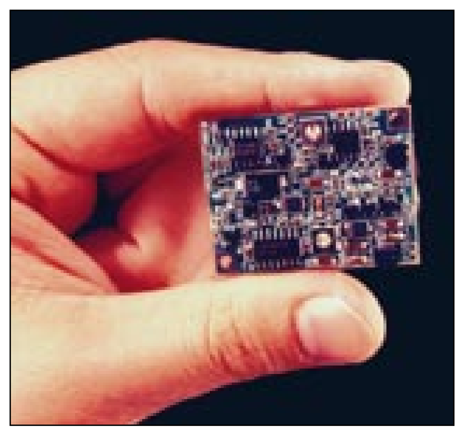
The NIF is being designed, built, and operated by Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Sandia National Laboratories, and the University of Rochester's Laboratory for Laser Energetics.



The NIF project will be completed by the end of 2003 with an initial operating capability of eight beamlines by the end of 2001.



The NIF will cost $1.2 billion. As with previous inertial confinement fusion lasers, technology developed for the NIF will advance our industrial capability. Construction and manufacturing industries throughout the nation will receive more than three-quarters of the NIF's funds.



There are many technology spin-offs from inertial confinement fusion research. For example, more than 20 companies have licensed the "radar on a chip" technology originally developed to measure processes occurring in Nova experiments. This inexpensive and highly sensitive radar will have commercial applications in many key U.S. industries, including construction, automobile, security, and medical.

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